National Research Council Canada

2008-2009

Departmental Performance Report

Minister of Industry

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Minister's Message

The past year has been a challenging one for the Canadian economy, as it has been for the economies of all industrialized countries. The global economic crisis put the fiscal and economic frameworks of all countries to the test. But Canada entered the recession with solid fundamentals — balanced budgets, decreasing debt and taxes, a strong financial sector and robust economic policies. Consequently, Canada is in a comparatively good position to effectively respond to this time of economic challenge.

The Industry Portfolio played a significant role in developing Canada's resiliency and ability to weather the current crisis. Composed of 11 departments, agencies, Crown corporations and quasi-judicial bodies, the Portfolio includes major instruments in the Government of Canada's tool kit for building a competitive economy.

The value and relevance of the National Research Council Canada's (NRC) research and supporting activities is evidenced by investments that partners have made in collaborative projects. In 2008–09, NRC had 596 active collaborative research agreements with Canadian and international partners (approximately 50 percent are industrial). NRC's active collaborations during the fiscal year were valued at $551 million, including $179 million leveraged from foreign sources. NRC has also been successful in commercializing its technologies, generating 111 new licensing agreements (a 13-percent increase since 2007–08) and $9.6 million in licensing revenue and royalties to help fund additional Canadian research.

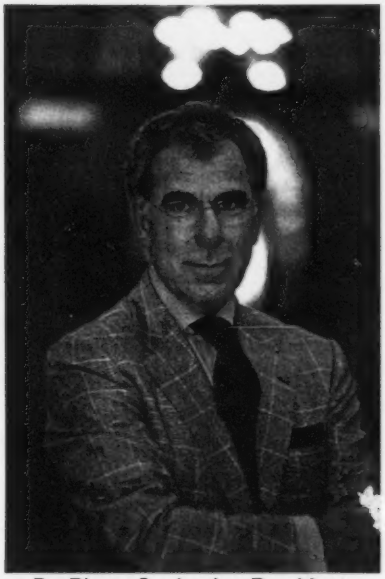
In January 2009, the government introduced Canada's Economic Action Plan, which contained stimulative measures to respond to the global recession. Industry Portfolio members played, and will continue to play, a central role in developing and implementing a significant number of these critical initiatives. These measures range from programs to upgrade research infrastructure at Canada's universities and colleges, to helping small businesses bring innovative products to market, to supporting major tourism events, to enhancing community and recreational facilities and other municipal infrastructure in Ontario. For more information, visit the Canada's Economic Action Plan website.

As a country, we are emerging from the recession by creating a climate that encourages innovation, productivity and competitiveness — helping Canadian industry move to the forefront of the global knowledge economy. The Industry Portfolio members, and other federal departments and agencies are working in partnership so that Canada continues to enjoy a high standard of living and a prosperous future.

It is my pleasure to present the NRC's Departmental Performance Report for 2008–09.

Tony Clement
Minister of Industry

President's Message



Dr. Pierre Coulombe, President

I submit for tabling in Parliament, the 2008-2009 Departmental Performance Report for the National Research Council of Canada.

The document demonstrates through specific examples how NRC contributes to the Government's Science and Technology Strategy and how NRC's value proposition *To bring integrated S&T solutions in areas of critical importance to Canada* is being implemented through its 2006-11 Strategy titled *Science at Work for Canada*. Specifically, it shows how, in 2008-09, NRC integrated its programs focused on areas critical to Canada's future with its implementation efforts in five key sectors and two national programs in support of the Strategy priorities; how it fostered a better integrated organization by assigning responsibilities to Vice Presidents and to some Directors General for NRC horizontal programs; and how it made changes to its financial system to enable horizontal reporting. In addition, NRC adopted a One-NRC client relationship management philosophy and created business guidelines. Finally, NRC integrated the Public Affairs Group into a Communications and Corporate Relations Branch and took steps to ensure that its human, capital, information technology and financial resources are fully aligned with NRC Strategy priorities.

This report is based on the principles contained in the *Guide for the Preparation of Part III of the 2008-2009 Estimates: Reports on Plans and Priorities and Departmental Performance Reports*. It adheres to the specific reporting requirements outlined in the Treasury Board guidance; it is based on the Strategic Outcomes and Program Activity Architecture that was approved by Treasury Board; it presents consistent, comprehensive, balanced and reliable information; it also provides a basis of accountability for the results achieved with the resources and authorities entrusted to it and it reports finances based on approved numbers from the Estimates and the Public Accounts of Canada.

I am sure you will find that this report presents a good picture of scientific innovation in Canada.

Section I – Overview

1.1 Raison d'être and Responsibilities

NRC is the Government of Canada's leading resource for science and technology (S&T) and innovation with a business focus on:

- improving the social and economic well-being of Canadians;
- fostering industrial and community innovation and growth through technology and industry support; and
- delivering excellence and leadership in research and development (R&D).

NRC Mandate

Under the *National Research Council Act*, NRC's authorities include:

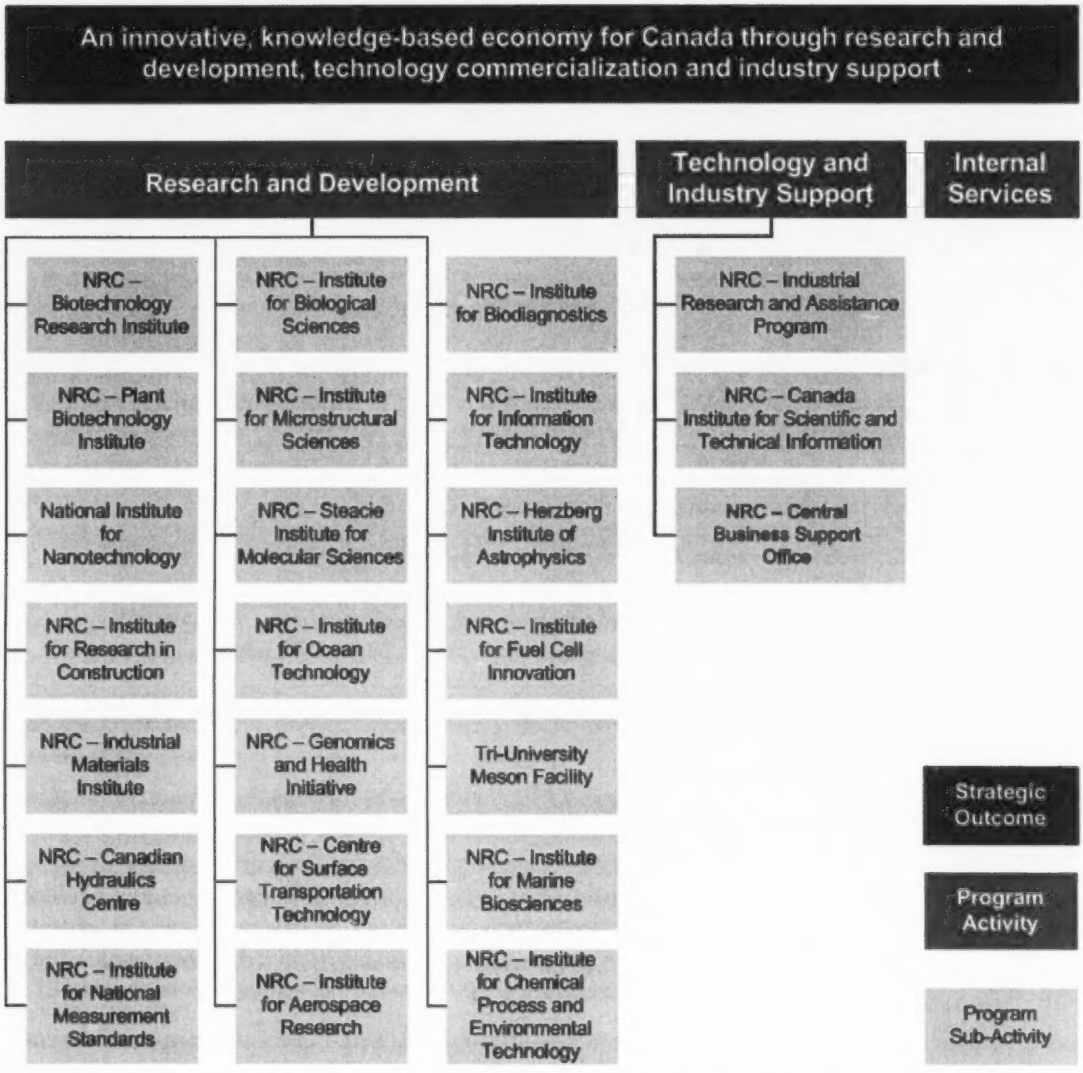
- Undertaking, assisting or promoting scientific and industrial research in different fields of importance to Canada.
- Establishing, operating and maintaining a national science library.
- Publishing and selling or otherwise distributing such scientific and technical information as the Council deems necessary.
- Investigating standards and methods of measurement.
- Working on the standardization and certification of scientific and technical apparatus and instruments and materials used or usable by Canadian industry.
- Operating and administering any astronomical observatories established or maintained by the Government of Canada.
- Administering NRC's research and development activities, including grants and contributions used to support a number of international activities.
- Providing vital scientific and technological services to the research and industrial communities.

Consult http://laws.justice.gc.ca/en/showtdm/cs/N-15 for more information on NRC's legislative framework.

NRC Accountability Framework

NRC is a departmental corporation of the Government of Canada, reporting to Parliament through the Minister of Industry. NRC works in partnership with the members of the Industry Portfolio to leverage complementary resources and exploit synergies in areas such as increasing the innovation capacity of firms through S&T, facilitating the growth of small and medium-sized firms (SMEs) and fostering the economic growth of Canadian communities. NRC's Council provides strategic direction and advice to the President and reviews organizational performance. The President is the leader, responsible for fulfilling corporate strategies and delivering results. Each of six Vice Presidents (Life Sciences, Physical Sciences, Engineering, Technology and Industry Support, Human Resources and Corporate Management) have responsibility for a portfolio of research Institutes, programs, centres or corporate branches. In addition, the Secretary General is responsible for NRC governance and accountability, ethics, conflict of interest, communications and corporate relations, corporate policy, and strategy and performance management.

1.2 Program Activity Architecture (PAA) 2008-09


An innovative, knowledge-based economy for Canada through research and development, technology commercialization and industry support
Research and Development
Technology and Industry Support
Internal Services
NRC – Biotechnology Research Institute
NRC – Plant Biotechnology Institute
National Institute for Nanotechnology
NRC – Institute for Research in Construction
NRC – Industrial Materials Institute
NRC – Canadian Hydraulics Centre
NRC – Institute for National Measurement Standards
NRC – Institute for Biological Sciences
NRC – Institute for Microstructural Sciences
NRC – Steacie Institute for Molecular Sciences
NRC – Institute for Ocean Technology
NRC – Genomics and Health Initiative
NRC – Centre for Surface Transportation Technology
NRC – Institute for Aerospace Research
NRC – Institute for Biodiagnostics
NRC – Institute for Information Technology
NRC – Herzberg Institute of Astrophysics
NRC – Institute for Fuel Cell Innovation
Tri-University Meson Facility
NRC – Institute for Marine Biosciences
NRC – Institute for Chemical Process and Environmental Technology
NRC – Industrial Research and Assistance Program
NRC – Canada Institute for Scientific and Technical Information
NRC – Central Business Support Office
Strategic Outcome
Program Activity
Program Sub-Activity

Research and Development encompasses NRC's responsibilities for performing R&D in strategic fields of science and engineering leading to the application of innovative technologies through commercialization and technology transfer in key economic and national S&T priority areas. These priority areas are environmental technologies, energy, health and related life science technologies and information and communication technologies, generating wealth for Canadians while being in alignment with the Government of Canada's S&T strategy and the Government of Canada's outcome of an innovative and knowledge-based economy. It also provides national science infrastructure for the benefit of industry, universities and government collaborators, such as facilities in astronomy and astrophysics and metrology.

Technology and Industry Support includes the provision of technology assistance, financial support and commercialization assistance to small- and medium-sized enterprises; dissemination of scientific, technical and medical information to industry, government and universities; and business-focused support to NRC executives and managers.

1.3 Performance Summary

2008-09 Financial Resources ($ millions)			2008-09 Human Resources (FTEs)		
Planned Spending	Total Authorities	Actual Spending	Planned	Actual	Difference
700.4	841.3	757.9	4,331	4,310	21

Except where noted otherwise, all financial results are reported on a cash accounting basis for historical comparability.

The Total Authorities includes unspent revenues carried forward from previous years. This ability to carry forward unspent revenue is included in the *National Research Council Act*. The revenue carry forward at the end of the year was $69.4 M. This is a significant portion of the $83.4 M difference between the Actual Spending and the Total Authorities. If the Total Authorities are reduced by the revenue amount, the Adjusted Total Authorities are $771.9 M and the difference between this and the Actual Spending of $757.9 M is $14.0 M. This is the true lapse for fiscal 2008-2009 and is a result of $4.2 M frozen in the operating vote for Employee Benefit Plan, $7.6 M frozen in the capital vote ($6.0 M re-profiled and $1.6 M for the capital carry forward into 2009-10), and $2.2 M lapse in the Transfer Payment Vote.

Strategic Outcome 1: An innovative, knowledge-based economy for Canada through research and development, technology commercialization and industry support.

Performance Indicators*	Targets	2008-09 Performance
Average incremental number of new and improved client products as a result of NRC's R&D activities compared to non-clients Average incremental client R&D expenditures as a result of NRC's R&D activities compared to non-clients Average incremental client R&D full-time equivalents employed as a result of NRC's R&D activities compared to non-clients	Establish baseline by 2009-10 with a 10% incremental difference in client innovation capacity in subsequent three years	NRC developed a statistical and econometric framework for measuring the economic impacts of its research and activities on its clients in comparison with non-clients. A key impact metric is client innovation capacity. This includes R&D capacity (i.e. R&D expenditures and R&D staff), commercialization (new and improved products and processes) as well as productivity. The analysis focuses on growth in client innovation capacity and NRC's influence on that growth. NRC worked with Statistics Canada to build the performance comparison models from 6 SME databases. Modeling and data analysis of over 10,000 client and matched non-client firms is on track for completion in 2009-10.

Program Activity	2007–08 Actual Spending ($ millions)	2008–09 ($ millions)				Alignment to Government of Canada Outcomes
		Main Estimates	Planned Spending	Total Authorities	Actual Spending	
Research and Development	465.8	417.6	419.2**	552.4	455.5	An Innovative and Knowledge-based Economy
Technology and Industry Support	193.8	203.0	203.0**	207.3	189.9	
Internal Services	111.5	77.7	78.2**	81.6	112.5	

Note: Due to rounding, figures may not add to totals shown.

* Strategic outcome performance indicators were developed during 2008-09.

**The distribution of Planned Spending across program activities differs in this report from that reported in the 2008-09 *Report on Plans and Priorities* (RPP) which does not include Internal Services as a separate program activity.

Contribution of Priorities to Strategic Outcome

Priority 1 R&D in Key Sectors and Areas Critical to Canada's Future	Ongoing	Met All

Linkages to Strategic Outcome 1

NRC targeted key sectors of Canada's economy, focusing its resources to deliver the greatest impact. NRC concentrated on four research priority areas, aligned with the federal S&T Strategy, namely environmental science and technologies; natural resources and energy; health and related life sciences and technologies; and information and communication technologies. Some examples include:

- Environmental Science and Technology: NRC's flagship investments in environmental science are the cross-NRC fuel cell and the national bioproducts programs. NRC worked with Natural Resources Canada (NRCan) and Natural Sciences and the Engineering Research Council of Canada (NSERC) on the development of a national research strategy.
- Natural Resources and Energy: NRC worked with 5 Canadian SMEs and other Canadian partners on green aerospace technologies by conducting collaborative projects in environmentally sustainable technologies focused on lower emissions, alternative fuels, reduced noise, compliant lighter materials and sustainable processes. NRC's portfolio of energy research was aligned with the eight portfolios of NRCan's Program for Energy Research and Development and ecoETI and numerous projects were undertaken in collaboration with NRCan. Agreements for scientific collaboration in the field of water quality have also been signed with several research groups in Canada.
- Health and Life Science: NRC continued to work to improve the health and wellness of Canadians by discovering and translating novel solutions for preventing, diagnosing and treating infectious and neurodegenerative diseases. NRC integrated its unique platforms in neurobiology, glycobiology and immunobiology with those in converging technologies (IT, nanotechnology and material science) in areas of diagnostics, therapeutics and vaccines.
- Information and Communication Technologies (ICT): NRC recognizes the role of ICT as a pervasive enabler for a wide range of applications. Its goal is to co-create with industry the convergent platform technologies that will ensure future global competitiveness of Canadian firms. For example, a project to develop sensor networks for commercial buildings was launched with the support of multiple stakeholders from the construction industry, sensor manufacturers, universities and other government departments. The project has three thrusts: location and occupancy sensing in commercial buildings; data mining for building management systems; and an innovative sensor network for indoor air quality.

To accelerate the commercialization of innovative products into the marketplace, NRC, NSERC and the Business Development Bank of Canada (BDC) worked to better align their programs and activities. The three federal agencies launched several pilot programs across Canada. Efforts to better serve clients included harmonizing due diligence processes and the co-location of both NRC industrial technology advisors at five BDC regional offices and the co-location of NSERC staff at two NRC Institutes. Together, the partners demonstrated commitment to strengthening Canadian SMEs' ability to use and profit from publicly funded expertise, technology and facilities; enhancing the exploitation of the results of public investments in public sector R&D; and, increasing the potential for success of high technology.

Priority 2 Community Technology Clustering Initiatives	Previously committed	Met All

Linkages to Strategic Outcome 1

NRC increased Canada's competitive advantage through investment in technology clusters across the country. Since 2000-01, NRC invested over $554 M in 11 technology clusters across Canada. NRC's commitment to fostering technology clusters catalyzed technological progress, innovation and economic growth across Canada. NRC's clustering model encouraged local entrepreneurship and created people advantage leveraging NRC knowledge and by capitalizing on its local, national and international resources, S&T capabilities, networks and partnerships. During 2008-09, over 325 NRC specialists were engaged principally in sharing their specialised expertise with cluster actors.

NRC's cluster initiatives delivered on the S&T Strategy's commitment to build a sustainable national economic advantage and a higher quality of life. NRC cluster initiatives worked with educational institutions and the private sector to build knowledge advantage through coordinated, leading-edge R&D programs and provided access to expertise and infrastructure. The cluster initiatives drove entrepreneurial advantage by enabling industry to translate knowledge into products, processes and services. They provided firms and related organizations with access to market and technical information and commercialization support to firms and related organizations. NRC worked with all cluster members (firms, provincial and municipal governments, communities, universities and technical colleges and organizations) to build people advantage by attracting highly skilled people to the regions, hiring and cross appointing researchers and providing hands-on training for over 430 students.

Priority 3 Integrated Industry Support that Engages Key Players	Ongoing	Met All
Linkages to Strategic Outcome 1 The Canadian innovation system comprises all the organizations that support and conduct research and transform knowledge into products and services for sale into both domestic and international markets. NRC identified and acted on opportunities for addressing gaps and weaknesses in Canada's innovation system that limit the nation's capacity to generate and transform knowledge into real economic value. For example, NRC's Canada Institute for Scientific and Technical Information (NRC-CISTI) responded to over 1,200 requests for custom competitive scientific and technical information and intelligence services. NRC's Industrial Research Assistance Program (NRC-IRAP) also provided over $70 M to innovation projects that supported 5733 jobs within SMEs generating a 4- to 12-fold net increase in wealth in Canada.		

Priority 4 Program Management for a Sustainable and Agile Organization	Ongoing	Met All
Linkages to Strategic Outcome 1 NRC adopted a Human Resources Management (HRM) Strategy focused on engaging talent, building capability and driving innovation. The HRM strategy supports the achievement of the NRC Strategy by mitigating the risks identified through the annual human resources environmental scanning process and by highlighting opportunities to build sustainable competitive advantage. The adoption of the HRM strategy, to be integrated in NRC's Corporate Plan, responds to the Office of the Auditor General's recommendation of an Integrated HRM Plan for NRC. NRC implemented an integrated approach to planning, risk management and performance management, complete with a new 2010-11 MRRS and Program Activity Architecture that support decision-making and enable strategy execution. NRC merged the Public Affairs Group with the Corporate Communications Group to form a Communications and Corporate Relations Branch to achieve operational efficiencies and to approach NRC's internal and external communications more strategically. While the group continued its focus on supporting NRC's business needs and initiatives and Government of Canada priorities, a higher level of support was delivered with an emphasis on stakeholder relations and corporate marketing. NRC's capital investment strategy was aligned with its priorities and, in order of importance, with health and safety, security, environment, energy efficiency and infrastructure renewal, respectively. NRC made capital investments in infrastructure of $9.4 M. While some projects addressed urgent backlog maintenance and infrastructure renewal, many achieved energy reductions through electrical, mechanical, automation and building envelope replacement.		

1.4 Risk Analysis

NRC prepared a Corporate Risk Profile in 2007-08 that fed into the planning and development of management priorities for 2008-09. The related risk management strategy addressed key developments and issues arising from that profile including: release of the federal S&T Strategy; the report of the Independent Panel of Experts on Inter-Sectoral Partnerships for Non-Regulatory Federal Laboratories; NRC implementation of its Strategy and resource focusing; studies that identified limited awareness and understanding of NRC by the Canadian public and other stakeholder groups; and addressing accountability requirements. Correspondingly, high priority risks were defined not only around the limited awareness issue, but also to address ongoing funding and financial challenges due to growing costs; attracting and retaining high quality people (HQP) with increasing global competition for the limited pool; and addressing external accountability requirements while supporting the implementation of NRC's Strategy.

The risks identified above must be addressed in order for NRC to effectively achieve its Strategic Outcome of an innovative knowledge-based economy for Canada through R&D, technology commercialization and industry support. NRC's continued success in innovation performance is driven by HQP. They are, in turn, drawn by NRC's strong reputation as a research organization and by the calibre of its scientists, as well as its excellent infrastructure. While NRC is generally known by its industry clients and partners, it needs to continue to maintain scientific excellence by sustaining and building on these aforementioned elements while gaining access to research/ operational funding. By doing so, NRC can ensure its value to industry, and Canada more

broadly. In addition, NRC needs to enhance communication of these assets to the scientific and technical talent within Canada and around the world, in order to attract and retain these resources.

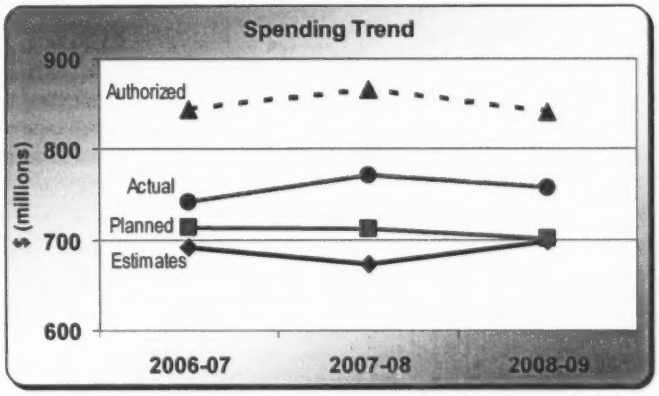
NRC determined priority areas in its 2008-09 risk mitigation action plan. These priorities focused NRC's efforts where they would have the most impact, addressing critical underlying issues that affect NRC at multiple levels. Examples of progress include:

Building the NRC image, and promoting its reputation and awareness: A Director General (DG) of Communications position was created in early 2009. The new DG position was part of broader re-structuring of this group to address communications-related issues. A Corporate Communications Strategy was approved in 2008 and its implementation will focus on: building multiple levels of engagement with stakeholders – growing awareness of NRC's value in the national innovation system; and broader support for the organization in the longer term.

Financial sustainability: This continues as an ongoing challenge for NRC. In 2008-09, NRC managed the results of an internal re-alignment exercise to prioritize NRC efforts, as well as a Strategic Review exercise led by the Treasury Board Secretariat (TBS). Work is focused on implementing coordinated strategies to reduce risks associated with funding pressures (e.g., cost savings, alternative funding resources) and ensuring longer term financial sustainability.

1.5 Expenditure Profile

Actual spending for 2008-09 was $757.9 million. Since 2006-07, actual spending increased by $15.8 million (or 2.1%). Actual spending has averaged $757.0 million over the three years and has remained relatively constant, varying less than 2% from average. The downward trend in planned spending is a result of initiatives such as Clusters and TRIUMF, which are currently under review for renewal of funding.



Voted and Statutory Items (millions of dollars)					
Vote # or Statutory Item (S)	Truncated Vote or Statutory Wording	2006-07 Actual Spending	2007-08 Actual Spending	2008-09 Main Estimates	2008-09 Actual Spending
55	Operating expenditures	445.6	422.9	385.5	429.6
60	Capital expenditures	49.9	45.1	39.7	42.4
65	Grants and contributions	136.0	148.1	143.6	141.8
(S)	Spending of revenues pursuant to the *National Research Council Act*	55.6	96.7	83.5	87.2
(S)	Contributions to employee benefit plans	54.6	57.6	46.0	56.5
(S)	Spending of proceeds from Disposal of Crown Assets	0.3	0.7		0.1
(S)	Collection Agency Fees	0.1	0.0		0.0
(S)	Loss on foreign exchange				0.3
	Total	742.1	771.1	698.3	757.9

Note: Due to rounding, figures may not add to totals shown.

Section II – Analysis of Program Activities

2.0 Strategic Outcome

> An innovative, knowledge based economy for Canada through research and development, technology commercialization and industry support

Significant structural changes in the economy often follow major economic crises. These changes are generally good opportunities to foster innovation. In the context of the recent economic upheaval in Canada, the federal government is working to ensure that businesses and research centres receive the necessary support to create these opportunities in the short term. As Canada's largest federal research body, NRC plays a leading role in the country's National Innovation System to build an innovative, knowledge based economy for Canada through research and development, technology commercialization and industry support. By virtue of its competencies, infrastructure, national and international networks and partnerships, it has a strategic role as the Government's key R&D instrument to address national issues of importance to Canadians and to collaborate with academia and industry to bridge knowledge creation and economic interests. Given the recent economic stresses on small-and medium sized businesses, NRC has played an even more critical role in helping sustain Canadian innovative activity to support economic recovery.

The value and relevance of NRC's research and supporting activities is evidenced by partners' investments in collaborative projects. In 2008-09, NRC had 596 active collaborative research agreements with Canadian and international partners (approximately 50% are industrial). NRC's active collaborations during the fiscal year were valued at $551 million including $179 million leveraged from foreign sources. NRC has also been successful in commercializing its technologies, generating 111 licensing agreements (a 13% increase since 2007-08) and $9.6 million (accrual based accounting) in licensing revenue and royalties to help fund additional Canadian research.

In terms of knowledge-generation, the publication citation impact factor (a main indicator of excellence, relevance and reach) of NRC has remained approximately 40% ahead of the world average and ahead of the Canadian and federal government averages for the past 26 years. NRC's publication productivity of 1.4 peer-reviewed publications per employee is amongst the highest of international science organizations. NRC researchers won awards of excellence including the Gerhard Herzberg Canada Gold Medal for Science and Engineering. (More)

2.1 Program Activity: Research and Development

2008–09 Financial Resources ($ millions)			2008–09 Human Resources (FTEs)		
Planned Spending	Total Authorities	Actual Spending	Planned	Actual	Difference
419.2	552.4	455.5	2,901	2,887	14

Expected Results	Performance Indicators	Targets	Performance Status	Performance Summary
Excellence and leadership in research that benefits Canadians	Intellectual Property (IP) Portfolio	By March 2011: 240 patents filed; 85 patents issued; 110 licences issued	Somewhat Met Exceeded Met All	NRC increased the flow of technologies into high-impact and emerging sectors of the economy. During 2008-09, NRC met or exceeded 2 of 3 targets set for March 2011. NRC introduced 109 product and process innovations to industry. It filed 183 patents, and 98 patents were issued. Issued licences increased by 13% to 111.
	Publications in refereed journals / proceedings and technical reports	Increase number of publications from previous year	Exceeded	In 2008-09, NRC researchers published 1,414 articles in refereed journals; presented 1,002 peer reviewed papers at S&T conferences and produced 6,142 technical reports for clients. In 2007-08, there were 1,330 articles in refereed journals; 821 in conference proceedings; 1,541 technical reports. The large increase in the latter is due largely to an improved system of counting calibration reports.
Contribution to federal strategies and initiatives	Leadership and contributions to federal horizontal initiatives	Growth trend	Met All	NRC continued to lead the federal Genomics R&D Initiative, now grown to 7 federal partners, in building and maintaining genomics research capabilities in government. During 2008-09, NRC played a major role in launching the National Bioproducts Program and in defining the scope and in launching 2 demonstration projects for the Hydrogen and Fuel Cell National Program.
Collaborative research with other innovation players nationally and internationally	Number and value of national and international collaborative agreements	Establish baseline for this new target	Met All	The value of NRC as a partner with industry is evidenced by the investment that partners make in collaborative projects. With a baseline of 1,280 industrial, academic and public sector collaborators successfully established in 2008-09, NRC was on track to meeting its March 2011 target of 1,408 collaborators. The lifetime value of these collaborations is at $551 M.
Community ownership of the cluster – local leadership and strategies	Industry Partnership Facility (IPF) occupancy rate for cluster initiatives	70% occupancy rate	Exceeded	NRC IPFs across Canada are unique workplaces for collaborative research and incubation of firms. NRC has 15 IPF locations across the country with occupancy of 82%. This exceeds the target of 70% occupancy. During 2008-09, 13 firms graduated from these facilities where they brought their innovations to a higher level of technology readiness. These graduates have been replaced by innovative co-locators, reflected by the occupancy rate of 82% which remains high and increasing slightly.
Greater productivity and increased new technology-based solutions	Technology transfer to cluster actors	Increasing trend	Met All	As the cluster initiatives (CIs) continue to advance their activities, interaction in the form of R&D collaboration has seen steady growth. In 2008-09, the CIs reported a high level of collaborative agreements signed comparative to earlier years, with 51 new agreements signed. This brings the total number of active agreements to 217. Many CI projects are multi-year agreements. Since the CIs began, they helped generate 53 new patent applications, and 26 new licenses have been granted by NRC. In 2008-09 alone, 16 patent applications were filed and 11 new license agreements were issued. These licenses and patents are aimed at increasing the productivity and innovation capacity of cluster actors. In 2008-09, the CIs signed more than 100 fee-for-service contracts supporting technological advancements.

2.1.1 Benefits to Canadians

Although the socio-economic benefits from scientific research can often take years to be visible, investment today is critical for future innovation and sustained global competitiveness. There are many players who contribute to the research continuum in Canada – from basic research to commercialization. These activities have long term impacts on many segments of the economy. The following are examples of achievements and milestones in longer term efforts demonstrating NRC's benefit to Canadians.

- NRC discovered a gene that could substantially reduce the use of nitrogen fertilizer for agriculture crops, reducing farm production costs at an estimated amount of $400-600 M per year (20-30% of nitrogen fertilizer expenditure - $2 B in Canada). It has also developed drought tolerant genes to increase crop yields, with an estimated positive economic impact of $304 M.
- Canada's economy is heavily dependent on manufacturing and transportation. Today, these sectors are challenged to reduce energy consumption and overall environmental impact, while competing with foreign companies operating in a lower-cost environment. To remain viable, Canadian companies need access to the cutting edge research provided by NRC. For example, Tru-Die, a Canadian SME is positioned to provide dies that could reduce the cost of vehicle manufacturing tools for the auto industry by up to 50% as a result of their collaboration with NRC. Similarly, Canadian fuel cell companies are poised to benefit from NRC fuel cells having twice the output of the current market leader. (More)
- Photonics applications surround us in the form of image recording and display, sensing, and information transmission. Serving an approximate $20 B industry in Canada (and broader world market), NRC's Canadian Photonics Fabrication Centre (CPFC) supported 45 key clients (28 repeat) in 2008-09. In the last 4 years, it helped three Ottawa based start-up companies create prototypes that resulted in approximately $70 M of funding being raised. CPFC spearheaded the creation of the International Photonics Commercial Alliance with 18 major stakeholders and over 500 individual public and private organizations across North America. Photonics is one of 11 NRC Technology Cluster Initiatives across the country that are facilitating partnerships between federal, provincial and municipal governments, industry, and the higher-education sector. Other cluster initiatives include: Nanotechnology, Life Sciences, Biomedical Technologies, Information and e-Business, Fuel Cell and Hydrogen Technologies, Plants for Health and Wellness, Sustainable Infrastructure, Aluminium Transformation, Nutrisciences and Health and Ocean Technology. These initiatives accelerate the commercialization of innovative technologies produced by small and medium-sized firms. Regional S&T capacity in key sectors and industries is being built across Canada to drive knowledge creation, economic growth and long-term global competitiveness.
- NRC collaborated with the University of Calgary, IMRIS Inc. and Canadian high-tech company MDRobotics (makers of the NASA Shuttle-based Canadarm) to develop a first-in-class robotic system for complex neurosurgeries. In the fall of 2008, the first human neurosurgery was performed by neurosurgeon Dr. Garnette Sutherland using neuroArm, with an excellent patient outcome. The collaboration exemplifies the Federal S&T Strategy objectives: People Advantage in the form of HQPs hired at IMRIS, Project neuroArm, MDRobotics and the University of Calgary to work on the project; Knowledge Advantage in the form of university, industry and hospital researchers working together to generate the knowledge necessary to develop the technology; and Entrepreneurial Advantage in the form of successful Canadian high-tech SMEs enhancing their product lines through innovation, as well as the development of an early-stage SME, neuroArm Inc.

2.1.2 Performance Analysis

NRC focused research on those sectors identified as having economic and social importance to Canada and within those sectors, concentrated on four research priority areas identified in the federal S&T Strategy,

namely environmental science and technologies; natural resources and energy; health and related life sciences and technologies; and information and communication technologies. In keeping with one of the Strategy's core principles – partnerships – NRC pursued horizontal initiatives and S&T collaborations with other federal departments and agencies and with universities, industry and the non-profit sector.

This report demonstrates the impact of NRC's R&D program activity and it informs Canadians of the progress made in implementing the S&T Strategy. The following examples are not meant to be exhaustive; rather, they show the scope and depth of NRC's activities, its commitment to getting initiatives up and running and to advancing the principles of Canada's S&T Strategy.

Environmental Science & Technologies

Hydrogen and Fuel Cell National Program – This is a joint initiative of NSERC, NRCan and NRC focusing on research, development and demonstration priority areas for Canada in the near to mid-term. A stakeholder workshop of 50 industry, academic and government research leaders was held in 2008 to establish the content of the national program and to identify the most pressing priorities for accelerating the commercialization of Canadian fuel cell technologies. In response to the workshop, NRC provided 3-year funding to two technology demonstration projects for reducing barriers to fuel cell commercialization and adoption in Canada.

In 2008–09, the Government of Canada officially announced investments of $13.6 million over three years in NRC's fuel cell and hydrogen technology cluster, an initiative that catalyzes broadly based community partnerships among industry, academia and the government to build Canada's competitive advantage through research, innovation and commercialization. This is also the site of NRC's public–private Hydrogen and Fuel Cell Gateway in Vancouver – a technology demonstration and exhibit centre showcasing Canada's fuel cell and hydrogen industry. These investments support important work in Canada's S&T Strategy.

- The Proton-Exchange Membrane (PEM) fuel cells project aims to reduce the cost and increase the longevity of PEM fuel cells by working on: high performance, low-cost catalyst; and high performance, low-cost membrane material. The project draws on expertise from Simon Fraser University, McMaster University and the University of Waterloo as well as NRCan and two of Canada's largest PEM original equipment manufacturers. (More)
- The Solid Oxide Fuel Cells (SOFC) project exploits NRC's expertise in thin film coatings to improve the expected lifetimes of the competing technologies currently in use. (More)

National Bioproducts Program – NRC negotiated a Memorandum of Understanding with NRCan and Agriculture and Agri-Food Canada (AAFC) that provides the governance framework for the three federal organizations to collaborate on the delivery of the AAFC-NRCan-NRC National Bioproducts Program. In line with the federal S&T Strategy, the Program is focused on the delivery of results having a positive impact in sustainable energy, the environment and rural revitalization. An external expert advisory body helped refine the R&D focus of the four large-scale projects in lignocellulosic-derived chemicals and energy; environmentally friendly biomaterials for various industrial sectors; production of energy and chemicals from biomass/ municipal waste; and the production of algal biofuel. Several external collaborators were identified to begin working with NRC in 2009-10 and various pieces of capital equipment procured. A project management system was developed to ensure timelines and scheduled deliverables are met. The four projects are expected to deliver concrete results to the private sector within two to three years.

Supporting Automotive Sector Innovations – NRC collaborated with the automotive sector, working on topics such as light weight materials, fuel cells, aerodynamics and manufacturing. A multidisciplinary team completed a comprehensive environmental scan and assessment of research in the automotive sector as part of the Automotive Assessment Study. (More) From this, NRC developed an integrated Automotive Strategy that identified three research areas: fuel efficiency, alternative propulsion and the connected car – all fields of critical importance to the environment, the industrial competitiveness and the market position for Canadian companies in this sector. This Strategy was also adapted to respond to the impacts of the current economic downturn and environmental concerns on this sector.

> NRC collaborated with Canadian electric and hybrid vehicle developers and battery manufacturers on improving the energy density and safety of the lithium ion batteries needed to make these vehicles commercially successful. Through the collaboration with NRC and licensing of NRC technologies, these Canadian SMEs became strong international players in this field. This strengthens Canada's green auto sector and has led to increased Canadian employment in this field. (More)

NRC also developed software to assist manufacturers of polymer moulded parts to improve the design by reducing weight, improving quality and ensuring environmental compliance. The success of this technology was augmented by NRC's creation of a Special Interest Group on Blow-Moulding, which brought together 30 private and institutional participants, providing contacts and opportunities for Canadian companies to build business relationships. (More)

Improving Marine and Arctic Operations – NRC developed leading-edge solutions to reduce environmental damage due to accidents and provide higher success rates for rescue operations. For example, NRC transferred technology relating to small craft training simulators to a Canadian SME. This SME employs personnel in Newfoundland and British Columbia and is set for expansion having just secured $1.5 million of additional private investment.

> Old ice is more hazardous than new ice and is responsible for an average of about 9 serious vessel collisions a year, with significant risk to life, great environmental risk and very high salvage and repair costs.

NRC partnered with industry to predict ice behaviour and risk around structures built on water such as off-shore oil rigs and long-span bridges. This research supported construction of more durable structures with a lower risk of environmental spillage (e.g. by oil rig detachment) and a longer life-span, thereby reducing waste resulting from disposal of ice-damaged components. For example, NRC produced a handbook to assist those piloting vessels in the Arctic in recognizing old sea ice (> 1 year old). The Canadian government and commercial organizations involved in Arctic transport have requested copies of the handbook and it is expected to become a critical part of the future of safe Arctic water travel, reducing environmental damage due to vessel collisions. (More)

Natural Resources and Energy

> NRC played a significant role leading to clean, low-energy enzymatic processes for hemp processing (Naturally Advanced Technologies) and pulp bleaching (Iogen), which both had significant positive environmental and economic impact for Canada. (More)

NRC partnered with Vaperma in Quebec to manufacture environmentally friendly separation technologies that could yield energy savings for the petrochemical and other industries. NRC used its expertise in casting and fabrication techniques of membrane materials and in membrane characterization and evaluation to develop a novel class of highly selective and permeable polymers that can efficiently separate gaseous compounds. These materials perform better than most currently available membrane polymers, allowing large amounts of desirable gas to flow through. NRC also helped Vaperma scale up the manufacture of these polymers from lab-size to industrial-size batches, reducing the time to synthesize test polymers from days to hours. Besides refining ethanol,

Vaperma foresees its products being used as a cost-effective way to separate water from other organic compounds. They could also be used to recover methane from crude natural gas and to purify manufactured biogases.

NRC collaborated with multiple players to create a new class of solar cells. While solar energy offers a natural and environment-friendly solution to rising energy needs, it currently provides only about 1 millionth of the total global electricity supply, due to the cost associated with harnessing solar energy. To meet this challenge, a consortium was assembled under Sustainable Development Technology Canada to develop a low-cost printable solar cell. The Consortium includes NRC, Université Laval, St-Jean Photochemicals Inc. and Konarka Incorporated. This project provides a technical base for the production of solar cells on lightweight flexible substrates, such as plastic film, in areas as large as can be produced by industrial printing presses. The Consortium estimates that this technology can enable a cumulative green-house gas reduction for Canada of more than 21 megatons by 2022 if the commercialized technology displaces the use of fossil fuels.

Health and Related Life Sciences and Technologies

NRC discovered and translated novel solutions for preventing, diagnosing and treating infectious and neurodegenerative diseases. For example, NRC developed an adjuvant and vaccine delivery technology (Archeosome technology) being evaluated for clinical applications by Piramal Health and Variation Biotechnologies; an antibody technology used in the development of an innovative cancer therapeutic by the Canadian company, Helix; and is collaborating with ApoPharma Inc. to evaluate new compounds targeting aspects of β-amyloid metabolism as potential therapeutics for Alzheimer's disease. NRC researchers also created a new source of nervonic acid that can fortify infant formulas and treat symptoms of neurological diseases such as Alzheimer's and Parkinson's.

NRC worked with Alethia Biotherapeutics in Montreal to commercialize antibodies exhibiting promise for diagnosing and treating breast, ovarian and possibly other cancers. The company attracted $4.6 M of venture capital financing and it began preparing for human clinical trials.

An R&D agreement was signed with Wellstat Vaccines to further develop synthetic polysaccharide conjugate technology to combat meningitis B disease. In collaboration with Dynport Vaccine Company, NRC is developing vaccines against dangerous airborne infections, specifically tularaemia, which poses a bio-security threat. The bacterium causing this disease is highly dangerous when aerosolized. For other examples of NRC contributions see (More, More).

Imaging Technologies for Diagnostic Applications – NRC, through what has been described as its revolutionizing functional magnetic resonance imaging, discovered that white brain matter (nearly half the brain) undergoes activation and serves the purpose of transporting information to different areas within various neural networks. This research was featured in an article in *BMC Neuroscience* and ranked as a top highly accessed paper in *NeuroImage*. It can lead to advanced clinical applications for disorders such as multiple sclerosis.

NRC spin-off IMRIS contributed to Canada's knowledge-based economy with further sales of medical instrumentation abroad. The company received CE mark of approval for its new interventional imaging systems and began European marketing of new products for advanced neurovascular and cardiovascular interventions. The company, with a current staff of 120, sold $4.8 M in the first quarter of 2009 and has confirmed orders of $84.1 M.

NRC and IMRIS Inc. collaborated on the research and development of a 16-channel MRI radiofrequency coil that provides better images of cardiac function than systems currently available. NRC developed the cardiac array, performed regulatory testing and conducted final performance testing of a beta production version of the array. With an exclusive licence from NRC, IMRIS will produce the coil.

NRC, together with Monteris Medical Inc., developed a temperature mapping system that permits more precise control of high intensity laser treatments of tumours. The technology, which recently received Food and Drug Administration (FDA) approval, destroys tumours from inside without affecting normal tissue.

Agriculture – NRC established the framework for enhanced engagement of critical agriculture sector players and quantified specific economic and industrial targets to be better able to assess performance. NRC research focused on ways to improve crop adaptation and productivity in response to climate influences and increasing global demand for healthier foods and feeds, environmentally friendly fuels and industrial products and new energy sources. With its expertise and capabilities in genomics, plant oils, plant bioactives, plant performance traits and genetic modification technologies, NRC produced prototype oilseeds (canola, rapeseed, flax), operated a seed genomics program on key Canadian pulse crops (i.e. lentils, peas, chickpeas, faba beans) to enhance Canada's reputation as a provider of high quality pulses and their products; and continued to develop a Strategic Crop Initiative to facilitate commercialization of modified plants beneficial to Canada's agriculture sector.

NRC worked with researchers in India, China, Germany and Netherlands in the area of genomics to improve agricultural commodities, resulting in 43 active collaborative agreements with industry, other government departments and universities with a total value of $32 M.

Functional Foods and Nutraceuticals – NRC provided essential expertise and infrastructure to facilitate private sector nutraceutical R&D. Early in 2009 several projects involving NRC, designed to support and drive economic growth and development, received funding from the Round VI Atlantic Innovation Fund. These included: Coastal Zones Research Institute Inc., Shippagan, NB to help develop technologies for extracting, isolating and characterizing bioactive ingredients from marine waste to create value-added products for natural health product and food markets, fisheries and microbiology; Solarvest Inc., Charlottetown, PEI to research nutraceutical applications of microalgae oils (lipids), which play a critical role in human and animal nutrition; and Keata Pharma Inc., Sydney, NS to develop and commercialize natural products, derived from daffodils, which can be used to treat Alzheimer's disease.

NRC developed a solubilisation technology together with Zymes to produce health beverages and foods. Currently, the company is using this technology to incorporate beneficial lipids into granola bars to be manufactured in Montreal. Zymes is also using the technology for "green" industrial chemistry applications.

Information and communications technologies

NRC strengthened Canada's leadership in information and communications technologies by creating and commercializing software and systems technology to help Canada prosper in the knowledge economy. NRC developed and integrated a Mobile Electronic Warfare Technology Suite on Bison Light Armoured Vehicles. They received high praise in their support of Canadian forces in Afghanistan. (More)

This year, NRC won an award for technology transfer from the Federal Partners in Technology Transfer for the transfer of its Factor technology to Nstein Technologies, a Canadian firm that provides digital solutions to the publishing industry. Factor is text-mining software developed at NRC that leverages Nstein's text analytics technology for content management, business intelligence and enterprise search solutions.

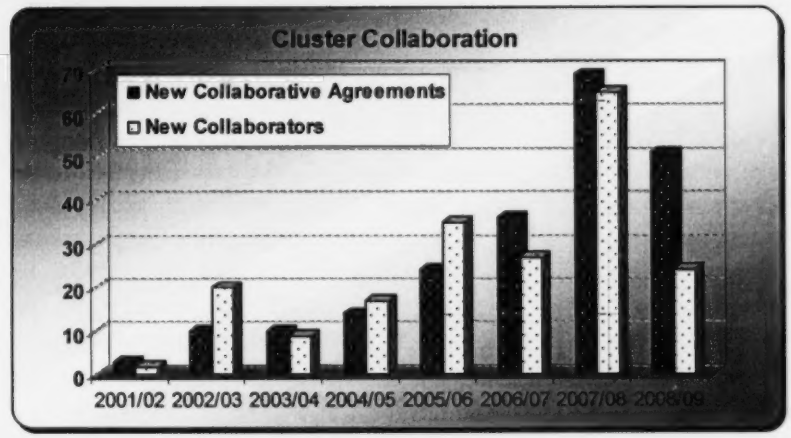
NRC's ICT Sector Strategy was aligned with the federal S&T Strategy, recognizing the role of ICT as a pervasive enabler for a wide range of applications. As a first initiative, a project to develop sensor networks for commercial buildings was launched with the support of multiple stakeholders from the construction industry, sensor manufacturers, universities and other government departments. The project has three thrusts: location and occupancy sensing in commercial buildings; data mining for building management systems; and an innovative sensor network for indoor air

quality. Collaborators include Adigy Canada, Boreal Laser, NRCan, Carleton University, Health Canada and six Institutes from across NRC applying a wide range of competencies to the project.

The Value of Technology Cluster Initiatives

NRC delivered Entrepreneurial Advantage through eleven community-based technology cluster initiatives that supported the integration of key players across Canada's innovation system. Clustering provided support by helping to build local scientific and innovative capability, which in turn supported development of a business environment capable of hosting and fostering dynamic and competitive industries. Clustering is a long-term process requiring focused attention and investment. Recent information obtained on the activities of NRC's cluster initiatives (CIs) continues to illustrate growth in activity and performance, confirming the spill-over effects of the investment in cluster strategies. Examples of progress include:

- Steady growth in the number of collaborative agreements signed with firms and other cluster actors with 217 separate agreements in place since inception. The most frequent participants in these research initiatives are firms followed by not-for-profit organizations and universities. Their participation demonstrates NRC's relevance to the private sector, as well as the need by Canadian companies, particularly SMEs, for the technological know how and capabilities of cluster initiative researchers.



- Growing knowledge of and use of advanced technology facilities and services available at cluster focused Institutes. The addition of new facilities, such as NRC-NINT in Edmonton, which is home to some of the world's most technologically advanced research facilities and houses ultra quiet laboratory space – the quietest such space in Canada, is helping Canada gain international attention from both large multi-nationals as well as local and Canadian companies. The Institute has attracted firms to co-locate staff in Edmonton in order to better access these facilities. Similarly, the Ottawa-based Canadian Photonics Fabrication Centre has witnessed consistent growth in usage and is recognized internationally for the quality and uniqueness of its service offering. Performance figures show an ongoing increase in the level of fee-for-service activity across the CIs, as well as access and usage of many facilities. More than 375 separate fee-for-service agreements were put in place since inception.
- The greatly enhanced presence of research capabilities. There are now more than 325 additional research and professional staff available in cluster regions to support cluster development. The additional staff include world-leading researchers focused on areas such as nanoscience, fuel cell and hydrogen technologies, photonics, and new areas of life sciences including nutrisciences and functional foods. The effect of these added competencies are leveraged through relationships with universities. For instance, cross appointments serve to enhance student training. At least 430 students have been hosted by the CIs, also giving them access to working with advanced facilities. The capabilities of NRC research staff are complemented by professionals focused on business dynamics and growth. NRC Business

Development Officers and NRC-IRAP Industrial Technology Advisors (ITAs) work one-on-one with existing and new businesses to enhance their likelihood of success.

Leading Edge Multi-Sector Research

Nanotechnology – NRC continued to help Canada stake its place in nanotechnology through research having a wide range of applications, from medical devices to construction materials. Research in the nanosciences is done across NRC at a dozen Institutes, the competencies of which have been brought together to contribute to two cross-Council programs focused on nanotechnology solutions for industry.

To accelerate the commercialization of innovative products into the marketplace, NRC, NSERC and BDC launched a program that brings together NRC scientists and university researchers with industry to ensure technologies resulting from approved projects would have receptors. The partnerships increased levels of cooperation resulting in more co-locations of employees and shared best practices. Regional innovation workshops were jointly organized and well received. Five 3-year nanotechnology projects were selected for funding in areas linked to the Federal S&T Strategy – environmental technologies, energy and ICT. Overall, seven NRC Institutes collaborated with thirteen universities and twenty-five other partner organizations. (More)

The NRC Nanotechnology program was launched in 2008 to leverage NRC research activities and fund five projects of strategic importance to Canada. NRC is tackling a wide range of subjects, which include the development of biosensors, photovoltaics, hydrogen storage materials and molecular electronics. Three of the five projects are on track to conclude in 2011, with the balance finishing in 2012. NRC is leading an effort to create one of the world's most sensitive small force detectors – an instrument that will determine physical characteristics such as adhesion, hardness and elasticity at the molecular level. Known as an Interfacial Force Microscope, it will provide detailed measurements of a material's small force characteristics and determine how it will behave in relation to other materials, permitting scientists to reliably engineer materials at the nanoscale (one billionth of a metre). The work is a core part of the NRC effort to provide quantifiable measurement standards for nanotechnology and is complementary to the creation of a nanoscale length standard being developed by NRC in conjunction with two universities.

Nanotechnology applications are becoming numerous, spanning a wide range of sectors. For example, single-walled carbon nanotubes can be used in a variety of industries, from sports equipment to airplane manufacturing. Two NRC Institutes collaborated in the development of nanotechnology-based composite materials offering improvements in applications for the aerospace sector. In 2008, Airbus awarded a research contract to NRC to develop conductive "nano-glue" adhesives to replace rivets presently used in aircraft assembly.

Aerospace – NRC continued to build competencies and conduct collaborative projects in environmentally sustainable technologies focused on lower emissions, alternative fuels, reduced noise, compliant lighter materials and sustainable processes. For example, NRC research has provided a number of breakthroughs expected to lead to millions of dollars in fuel savings through their developments in reducing drag on aircraft wings (More) and advances in fibre placement (composite) materials to provide lighter-weight aircraft (More) and to provide lower weight, more efficient, quieter engines. (More)

NRC collaborated with Canadian aerospace SMEs and other companies to improve their product and process development capabilities. For example, NRC has collaborated with Composites Atlantic Limited (CAL), an SME headquartered in Nova Scotia to enhance CAL's capabilities in conductive bonding and laser ultra-sonic inspection. As a result, CAL has developed relationships with Bell Helicopter and Bombardier, opening up the possibility for major supply contracts for CAL and resulting employment for

Canadians. (More) In addition, NRC has developed technologies in testing and analysis of full-scale aerospace structures and has made this expertise available to Canadian SMEs who would otherwise be unable to compete due to their inability to access such capital-intensive test equipment. (More)

NRC maintained technical excellence in advanced materials and structures, advanced propulsion systems, aerodynamics, advanced manufacturing and avionics and flight operations. For example, NRC has provided research results that will increase engine efficiency by increasing compressor and/or turbine loading (More) and has led key research in aircraft de-icing technologies and engine assessment for threats due to icing. (More) In addition, NRC has developed an integrated visionic, sensor and mission system that is now in active use and has increased effectiveness and safety for night or poor-visibility flights. (More)

Construction – NRC implemented its construction strategy through research and technology development; codes and standards; and information dissemination. In 2008-09, NRC focused on building technologies to reduce energy consumption and promote health and safety. It provided technologies and critical information on indoor air quality in buildings and aircraft and the use of sensor arrays linked to decision-making tools for more efficient operation of indoor environments. Key contributions were made through such multi-partner initiatives as:

- Indoor Air Quality/Clean Air Initiative in cooperation with Health Canada and Environment Canada: Development of the Canadian Building and Health Sciences Network (CBHSN), (170 members in 2008-09) and workshop. The latter is a partnership between NRC, Canada Mortgage and Housing Corporation, Health Canada and the Canadian Institutes of Health Research. Led by NRC, this workshop established a preliminary framework for actions to improve Canadians' health through the physical environment. NRC, with its partners, built a laboratory for indoor air quality research.
- Barriers to the integration of fuel cells and hydrogen technologies in buildings – NRC led and completed consultations with industry around the potential for integration of fuel cells and hydrogen technologies in buildings.
- Impact energy consumption in the built environment – NRC partnered with BC Hydro to evaluate the performance of energy-saving lighting control systems. (More) NRC tests identified a system that achieved overall energy savings of approximately 69%.

NRC filled critical knowledge gaps in the fire performance of innovative materials and provided valuable scientific information to impact codes and standards for fire safety in Canadian homes. NRC also developed performance metrics and decision support frameworks for the management of Canada's aging municipal infrastructure.

Manufacturing and Materials – NRC continued helping Canada's manufacturing sector face major challenges including the economic downturn, increased competition and strong innovation investment from foreign markets. The NRC Manufacturing and Materials Key Sector Strategy addresses the challenges of four manufacturing segments: primary metal, plastics and composites, metal fabricated products and machinery.

NRC conducted leading-edge research in the fields of nickel and aluminum to help Canadian companies. For example, NRC has assisted a number of Canadian SMEs in the nickel industry to produce metals more efficiently. (More) NRC made available cutting-edge innovations and equipment that helped a network of Canadian SMEs succeed in the aluminum field. Through its Aluminum Technology Centre, NRC played an active role in the development of the Saguenay-Lac-Saint-Jean aluminium cluster, including providing access to specialized equipment in support of laser welding, aluminum forming and semi-solid casting in the region. NRC has leveraged its relationships with large international firms to provide a node of access

for Canadian companies to these firms. As a result, commercial opportunities arose for Canadian companies. (More, More)

NRC's work has allowed Canadian companies to improve their manufacturing efficiency, reduce development time and prototyping costs and improve the quality of their manufactured components. For example, NRC assisted Windsor-based Kautex to design an innovative plastic gas tank for the automotive industry. Using NRC technology, they were able to produce a lighter product that uses less material and is less expensive to produce. These advances provide Kautex with a competitive advantage in this market while increasing fuel efficiency and reducing environmental impact. (More)

Standards – Metrology and Building Codes and Standards – NRC is mandated to determine standards and methods of measurement that have an impact on the ability of Canadian industry to trade internationally. While in the past these were primarily traditional physical measurements, the advent of new technologies is compelling NRC to establish measurement standards in such domains as biotechnology and the nanosciences. Canada's participation in establishing the initial standards for emerging technologies gives a competitive edge to innovative Canadian firms, providing them with early access to state of the art international standards for effective participation in global markets. In addition, NRC maintained other traditional global standards that are critical for Canada's participation in international trade.

For instance, NRC worked with FPInnovations Paprican and laboratories abroad to ensure that companies from around the world have access to the highest quality standards for paper whiteness, since very white paper commands premium prices. NRC, which is recognized as the world authority in paper whiteness measurements, developed the reference instrument that establishes the absolute whiteness level for paper. Paper companies around the world trace their whiteness measurements to those of NRC. For Canadian suppliers like Domtar, this allows them to guarantee the quality of their product to their customers and has saved them money.

NRC worked with the Canadian codes community (CBHSN) in developing a single energy standard for buildings and housing. Through collaborative work associated with the CBHSN initiative, and beginning by convening a cross-disciplinary workshop of experts across Canada, NRC worked with the health community to examine the impact of indoor environment, such as air quality, on health for reducing health care costs and absenteeism related to indoor environmental issues.

Leverage "Big Science" Partnerships – Since its creation in the 1970s, TRIUMF continues to be a key investment for Canada in large-scale research infrastructure. TRIUMF provides world-class facilities for research in sub-atomic physics, including nuclear physics, nuclear astrophysics, particle physics, nuclear medicine and materials science and encourages the transfer of technology developed at the laboratory into the marketplace. NRC provides funding for the operations of this facility on behalf of the Government of Canada via a contribution agreement. In 2008, TRIUMF, in collaboration with MDS Nordion, continued to generate cyclotron-produced medical radioisotopes for over two million clinical treatments in North America. TRIUMF has a 2005-2010 Plan, with five-year funding totalling $222 million. The next Plan for the period 2010-2015 was reviewed by an international expert committee in September 2008 and its report was endorsed by NRC Council.

Canadian Astronomy and Telescopes – Activities were driven by international agreements that provided Canadian researchers with access to world-leading observatories. In 2009, the International Year of Astronomy, NRC worked with an international team to capture the first images of three planets circling a star 130 light years from Earth in the constellation of Pegasus.

Patented astronomy technology from NRC was tested in a giant step toward completion of the U.S. Expanded Very Large Array (EVLA) in New Mexico. The test demonstrated the power of NRC's Wideband Interferometric Digital Architecture (WIDAR) correlator, a high-performance supercomputer that combines signals from many radio-telescope antennas. The EVLA Project is scheduled for completion in 2012. The resulting radio-telescope system will be ten times more capable as a scientific instrument, allowing astronomers to observe fainter and more-distant objects.

Dr. Christian Marois of NRC was named Scientist of the Year 2008 by Radio-Canada. This award recognizes his team's achievement in capturing the first-ever images of planets circling a star other than Earth's Sun. In addition, the discovery of these planets was lauded as an outstanding breakthrough by major science publications including:

- *Science*: recognized the first direct images of exoplanets as the second biggest scientific breakthrough of 2008.
- *Space.com*: The popular web site ranked the team's discovery as the top astronomy story of the year.
- *Time Magazine*: The discovery ranked sixth amongst the magazine's "Top 10 Scientific Discoveries of 2008".

To celebrate the International Year of Astronomy, NRC pursued education and public outreach in Astronomy with over 107,000 Canadians having experienced a personal astronomical discovery, a '*Galileo Moment*'. NRC created a downloadable internet video of a traditional Mi'kmaq night sky story that links to current astronomy knowledge. NRC outreached to school aged children through the programs of the Centre of the Universe in Victoria, many of which are run in collaboration with other organizations, such as the Victoria Symphony Orchestra, the Canadian Space Agency and diverse educational groups.

Canadian Neutron Beam Centre – NRC applied novel neutron beam methods to soft materials and nanostructures, enabling scientists to investigate materials at the atomic scale. NRC's beam facility operated at capacity on a 24/7 basis, devoting more than 50% of spectrometer time to support research by Canadian university scientists and students. The overall capacity for access increased this year by 20% with the addition of the D3 neutron reflectometer that enabled greater access to researchers in the domain of nanostructured thin films. This year, 117 researchers accessed the facility representing industry, government and academic institutions.

The additional capacity allowed NRC to expand its research activities in nanotechnologies for antibody treatment of tumours. The research led to a provisional patent filed in 2008, a Non-Disclosure Agreement in developing PET (positron emission tomography) contrast agent carriers with McGill University and a long-term Memorandum of Understanding (MOU) for developing molecular imaging techniques between NRC and MDS Nordion, a leading global life sciences company.

2.1.3 Continuous Improvement

Project Management – Following a key recommendation of the Auditor General on research project management, NRC took action. A Project Management Manual, which conforms to the practices recognized by the Project Management Institute and to the NRC's Corporate Manual, was developed and made available on a MS-Sharepoint information system site as a pilot project. The system was used to improve the efficiency and accountability of the selection process for scientific projects in accordance with strategic objectives. The lessons from the pilot project are under review for consideration of implementation across NRC.

Industry Push versus Industry Pull – Allowing firms to identify opportunities and responding to these constitutes an important ability as a cluster catalyst. NRC learned the importance of listening and responding to industry needs. NRC will continue to explore and adopt flexible approaches, such as allowing industry to participate in identifying necessary research competencies to fill gaps and hiring new resources according to these needs.

2.2 Program Activity: Technology and Industry Support (TIS)

2008–09 Financial Resources ($ millions)			2008–09 Human Resources (FTEs)		
Planned Spending	Total Authorities	Actual Spending	Planned	Actual	Difference
203.0	207.3	189.9	709	705	4

Expected Results	Performance Indicators	Targets	Performance Status	Performance Summary
Improved dissemination of knowledge	Client satisfaction with NRC information services	80%	Met All	1) The NRC Publications Archive and PubMed Central Canada initiatives were launched to improve access to the results of Canadian federal government funded research. 2) NRC Research Press enabled open access to client scholarly journals. 3) A national study on the impact of NRC information services was carried out with clients interviewed at 5 sites across Canada. Preliminary results indicate that all needs are met.
Enhance innovation capacity of firms	Increase annual contribution expenditures	Secure 24% increase funding to assist SMEs	Somewhat Met	100% of contributions budget ($88.5 M) was committed by June 2008. Field staff aggressively helped SMEs develop eligible R&D projects. As part of Canada's Economic Action Plan, NRC received a temporary increase of $200 M over 2 years (2009-10 and 2010-11).
Supporting Canadian industry and advancement of new technology-based companies	Increase client reach	Increase in funded clients by 25% over FY 2006-07	Not Met	Average funding per client project increased by 25% with a new focus on longer term projects of potential higher success and impact. Consequently, the number of funded clients declined.
	Highly qualified engineers and scientists to SMEs	Increasing trend	Exceeded	Advisory assistance was provided to 6,349 firms – an increase of 12% from 5,587 the previous year.
Competitive R&D base in cluster communities	Access and use of TIS services by cluster actors	Establish baseline for this new performance indicator	Met All	During 2008-09, 156 cluster actors accessed and used industrial research assistance services. 10,491 requests for scientific and technical information services were received from cluster actors. This establishes the baseline. Moreover, $2.99 M was expended to support 36 innovation projects with cluster firms and 18 with organizations to ensure availability of needed services for SMEs within the specific clusters.

2.2.1 Benefits to Canadians

NRC's Canada Institute for Scientific and Technical Information, as Canada's national science library and leading scientific publisher, provided Canada's research and innovation community with tools and services for accelerated discovery, innovation and commercialization. The record of Canadian science is strategically collected in the NRC Publications Archive and the PubMed Central Canada digital repositories. NRC demonstrated leadership in the emerging need to manage and provide access to Canadian scientific

datasets, while also providing Canadian SMEs and NRC researchers with high value analysis, patent searches and market intelligence. These activities enabled better research and commercialization decisions and more successful outcomes through information and intelligence services.

NRC supported Canadian wealth generation through the funding of specifically-identified industry projects. NRC Industrial Research Assistance Program (NRC-IRAP) strengthened the Canadian innovation system by supporting regional and national research and development organizations, assisting individual firms with improving their own innovation capacity through specialized advisory services and providing relevant and challenging work experience for recent university graduates to develop the next generation of highly qualified research and development personnel. The social well-being of Canadians was also enhanced through NRC's support of its clients' products, many of which fell within the federal government's key strategic areas of health, environment, energy and ICT.

2.2.2 Performance Analysis

Build Innovation Capacity within SMEs – NRC-IRAP provided comprehensive innovation assistance to technology-based SMEs in support of the Federal S&T Policy. NRC enhanced services in such areas as: facilitating multi-stakeholder collaborations; forging stronger links for technology based SMEs to access publicly-funded research and sources of technology; and, supporting SME efforts to access foreign technology and form international alliances.

In 2008-09, $70.6 million in financial contributions were made to 1,463 SME clients for 1,717 projects through NRC and 6,349 Canadian SMEs received technical, research and business assistance. These projects supported 5,733 jobs within SMEs and 540 youth graduates through Canada's Youth Employment Strategy. For example, one project supported Tool-Tec Welding in developing an automated robotic multilayer Tungsten Inert Gas welding system. The Ontario Company grew from a small welding shop into an R&D capable organization while doubling the number of employees.

A recent evaluation study indicated that the total wealth creation benefits of NRC-IRAP between 2002 and 2007 range from $2.3 B to $6.5 B, exceeding costs by a factor of 4 to 12.

NRC hosted themed events on Innovation that were attended by over 2,000 SMEs. Themes included: Process intelligence, Human Resources, Environment/Energy, New Product Development, Commercialization, Health and Safety and Supply Chain Logistics. Client surveys revealed that 90% of participants experienced innovation, productivity improvements/gains, reduced cycle time and increased profit margins, which led to an improvement in their company's competitive position.

Scientific and Technical Information – NRC-CISTI provided Canada's research and innovation community with tools and services for accelerated discovery, innovation and commercialization. This includes an information intelligence service that offers information synthesis, analysis and competitive technical services to institutes, clusters and NRC industrial technology advisors across Canada. The result was improved decision-making and outcomes in the areas of research focus and commercialization of that research. (More)

NRC leveraged its metadata expertise to develop a gateway Web site that provides access to Canadian scientific data sets and other data repositories. NRC convened the Research Data Strategy Working Group comprised of leading organizations across Canada.

NRC improved access to the results of Canadian federal government funded research by the Canadian innovation community and the public.

- The NRC launched the NPArC Publications Archive digital repository that includes all NRC publications.
- NRC and the Canadian Institutes of Health Research (CIHR) signed a memorandum of understanding to partner for development of PubMed Central Canada, which will enable access to the results of all research funded by CIHR. NRC started negotiations with the US National Library of Medicine (NLM) to include the NLM PubMed Central content.

NRC signed the founding and purpose document for the WorldWideScience Alliance that provides free access to national scientific databases, such as the NRC collection, from around the globe.

NRC published a record number of new monographs, increased subscriptions by 25% and strengthened relationships with partners and clients. Two NRC Research Press journals received a prestigious honour: *Botany* (formerly *the Canadian Journal of Botany)* and the *Canadian Journal of Forest Research* were each selected as one of the 100 most influential journals in biology and medicine over the last 100 years as voted by the BioMedical & Life Sciences Division of the Special Libraries Association.

NRC Research Press continued to innovate, implementing two new journal features: open access enablers such as author pay and delayed access; and article aggregations for specific NRC strategic research initiatives. A client-journal web-based platform that provides enhanced e-publishing services was completed. *The Canadian Journal of Ophthalmology* and *The Canadian Entomologist* became the first two client journals to be published using this platform.

Commercialization Support, Technology Transfer and Intellectual Property Management – NRC provided SME clients with customized value-added advice, information, referrals and financial assistance in approximately 100 communities across the country. NRC's Industry Technology Advisors (ITAs) worked with clients at all stages of the innovation–commercialization continuum, including: project development; access to technical assistance, financial, business, marketing or management advice; access to competitive technical information; patent searches; and access to local, regional, national or international linkages. The ITAs also provided technical and business support, mentoring and referrals to government Institutes and industry programs and initiatives. NRC's Innovation Network Advisors represented and promoted NRC in the community innovation system and built effective regional innovation system relationships for the benefit of SMEs. This included working with clients and other organizations to facilitate the implementation of multi-sector, multi-partner initiatives that were relevant to SMEs regionally and nationally.

A Central Business Support group was established to facilitate the flow of high-value technology from NRC while providing business-focused support to NRC executives, Institutes and programs. It championed the needs of industry and other clients to develop cohesive, consistent, business-friendly guidelines. It helped NRC manage its IP assets more strategically while facilitating horizontal business activities. This included developing a pilot Client Relationship Management (CRM) process and system. The pilot was tested by NRC Aerospace together with three other key sectors. Processes were put in place for identifying and managing key Aerospace accounts including the management of client feedback. The pilot was successful and work commenced to implement the system across NRC.

The NRC Disclosure Review process was identified as exemplary across the Federal Government by the Office of the Auditor General (OAG) during their recent audit. NRC completed market assessments as well as the traditional patentability assessments on early stage technology at the disclosure stage where scientists are obliged to report inventions. This brought a better understanding of potential market impacts to Institutes' decisions-makers. NRC scientists reported 109 inventions in 2008-09.

2.2.3 Continuous Improvement

NRC conducted a pilot project to streamline the processing of NRC agreements. The project focused on shortening the time to negotiate and approve NRC's larger business agreements. It featured a fast-track for processing the most urgent cases. This helped forge stronger links between corporate players in the contract approval process while improving service delivery. Feedback was positive. NRC learned that client satisfaction surveys are an important method of determining the effectiveness of service delivery models as well as the relevance of the content. NRC has therefore begun to regularly schedule detailed client surveys, to formally keep abreast of feedback and ensure that client needs are met.

2.3 Program Activity: Internal Services

2008–09 Financial Resources ($ millions)			2008–09 Human Resources (FTEs)		
Planned Spending	Total Authorities	Actual Spending	Planned	Actual	Difference
78.2	81.6	112.5	721	717	4

Expected Results	Performance Indicators	Targets	Performance Status	Performance Summary
• Long-term stability of financial, human and capital resources • Progress towards delivery of NRC strategy aligned with federal priorities • Sustained, effective corporate governance and decision-making • Effective research management • Effective communications with NRC stakeholders	HR turnover rates	5% turnover rate of continuing employees by March 31, 2011	Met All	Total employee-driven turnover of continuing employees decreased to 3.6%. (More)
	Percentage of operating budget allocated to training	1.7% of salary invested in learning by March 31, 2011	Met All	In 2008-09 NRC invested 1.9% of salary in learning including corporate leadership and management development programs. This is a 1.7% increase over the previous year.
	Capital investment in infrastructure	Constant capital investment	Met All	NRC made capital investments in infrastructure of $9.4 M compared to $9.5 M in the previous fiscal year.
	Diversity and Official Languages statistics	Representation equals market availability	Mostly Met	Representation of visible minorities surpassed availability. Representation of women decreased slightly from 2007-08. The gap for aboriginal persons and persons with disabilities increased in 2008-09. Approximately 89% of employees met the linguistic requirements of their position.

2.3.1 Benefits to Canadians

The efficient functioning of the NRC governance structure ensures that NRC has, at all times, the tools necessary to make the best possible management decisions to pursue its value proposition: "To provide integrated science and technology solutions in areas of critical importance to Canada".

2.3.2 Performance Analysis

NRC completed plans for implementing the NRC Strategy that reflects changing internal and external factors, as well as the ongoing decisions and priorities of the federal government. It describes steps to implement increasingly horizontal R&D initiatives, which involve contributions from NRC, other government departments, the private sector and academia. These initiatives are focused on addressing the needs of key industrial sectors of the Canadian economy and enduring issues facing the nation including health and wellness, sustainable energy and the environment.

Integrated Solution to Planning, Risk and Performance Management – NRC implemented an integrated approach to planning, risk management and performance management that supports decision-making and enables strategy execution. An integrated project team comprised of members from finance, human resources, information systems and corporate services accomplished the following: 1) Completed a second cycle planning process to ensure alignment of operational planning to the NRC Strategy; 2) Developed a new 2010-11 MRRS, Program Activity Architecture and performance measurement framework aligned to NRC Strategy and approved by Treasury Board on May 28th, 2009; 3) Approved targets for performance measures contained within the Corporate Balanced Scorecard for the NRC Strategy and Institute, Program and Branch plans; and, 4) Created a financial and non-financial reporting information system using SAP Business Intelligence solutions allowing access, analysis, sharing and reporting of financial and non-financial information across the organization to support internal decision-making and the MRRS requirements. The new processes, performance measures and associated targets allow NRC to assess strategy implementation progress. Plans were made to further develop and refine the Business Intelligence information system and to train users across NRC in 2009-10.

Governance and Accountability Structures – NRC adopted a process for managing disclosures pursuant to the *Public Servants Disclosure Protection Act* and the NRC Corporate Governance Group initiated a program to inform NRC managers and staff of the provisions of the *Act* and of the NRC process.

NRC also conducted a formal Audit Survey of its Values and Ethics systems in 2008-09 with specific emphasis on the roles and responsibilities of NRC Corporate Governance. The results of this Audit Survey guided planning for the next year.

Effective Information Technology (IT) Management – NRC became a member of the TBS Chief Information Officer Council and has since participated in numerous working groups. NRC reviewed its IT Service delivery model and identified the need for more consistent organization-wide service, including the establishment of an NRC IT Steering Committee to oversee NRC's federated model. The committee oversees the development of an NRC IT Plan, ensuring that common or shared IT assets and services are used and performance related to NRC's management of IT is measured.

Talent Attraction, Management and Retention – NRC's Human Resources Management (HRM) Plan was developed during 2008 to preserve leadership capacity. NRC began to integrate succession planning and management in the business planning process and to improve education efforts with Human Resources Professionals, senior managers and planners. For example, NRC collaborated with another government agency in the development of a Management 101 program and it prepared to offer the training during 2009-10 using both e-learning and in-class training.

NRC conducted an extensive review of its recruitment programs, policies and practices by consulting with NRC management teams at all levels, human resources professionals and new hires. Following this analysis, best practices research was initiated and a draft NRC Recruitment Strategy Action Plan was developed for Senior Management approval.

Communications – Through the development of NRC's three-year communications outlook, it was determined that NRC required a more robust and strategic communications capability. As such, the Communications and Corporate Relations Branch was created in 2009. A six-month communications transition plan that sets priorities for the Branch during the integration was developed and launched. These priorities included: stakeholder relations; rejuvenating NRC's communications function; supporting and developing partnerships; implementing an NRC marketing strategy; supporting key NRC initiatives; and, making use of leading-edge communications approaches and technologies.

Maintaining and Upgrading NRC S&T Infrastructure – NRC made capital investments in infrastructure of $9.4 M. While some projects addressed urgent backlog maintenance and infrastructure renewal, several achieved energy reductions through electrical, mechanical, automation and building envelope replacement. The capital investment strategy was aligned with NRC's priorities and, in order of importance, with health and safety, security, environment, energy efficiency and infrastructure renewal, respectively.

2.3.3 Continuous Improvement

The Communications and Corporate Relations Branch was created as NRC realized that a strong, central communications capacity was needed if the organization was to be successful in taking a more concerted, strategic approach to communicating with its stakeholder communities. Prior to its creation there were, in some instances, duplication of efforts and challenges in establishing project leadership and/or responsibility and a lack of consistent messaging.

Section III – Supplementary Information

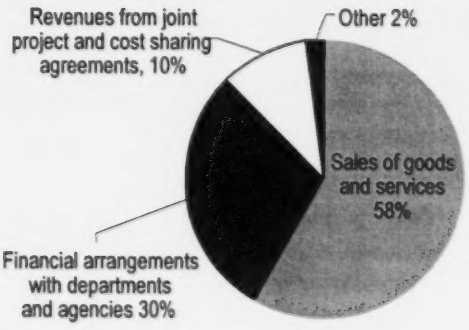
3.1 Financial Highlights

The following general overview of NRC's financial position and operations are presented on an accrual basis for comparability with the complete financial statements published on NRC's Web site.

Condensed Statement of Financial Position ($ thousands) at End of Year (March 31, 2009)	% Change	2009	2008
ASSETS			
Total Assets	(4 %)	821,313	851,212
TOTAL	**(4 %)**	**821,313**	**851,212**
LIABILITIES			
Total Liabilities	**6 %**	**329,943**	**310,397**
EQUITY			
Total Equity	(9 %)	491,370	540,815
TOTAL	**(4 %)**	**821,313**	**851,212**

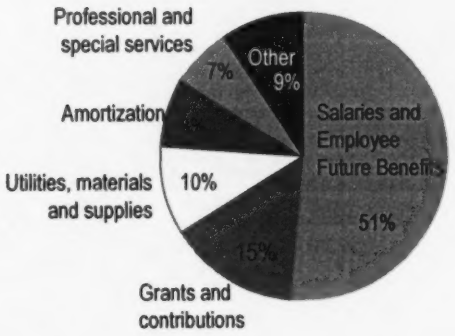
Condensed Statement of Operations ($ thousands) at End of Year (March 31, 2009)	% Change	2009	2008
EXPENSES			
Total Expenses	5 %	899,430	852,988
REVENUES			
Total Revenues	1 %	156,246	154,530
NET COST OF OPERATIONS	**6 %**	**743,184**	**698,458**

Revenues by Type (2008-09)


Revenues from joint project and cost sharing agreements, 10%
Other 2%
Sales of goods and services 58%
Financial arrangements with departments and agencies 30%

Revenue is important to NRC, not only as a means of financing its operating and capital expenditures, but also as an indication of the value that NRC provides to its clients and collaborators. NRC earned total revenues of $156 million in 2008-09, up slightly from $155 million earned in 2007-08. NRC's largest component of revenue results from the sale of goods and services, primarily consisting of research services provided to industry and academic clients ($66 million), with the remaining balance provided by the sale of goods and information products ($11.3 million), and NRC rights and privileges ($9.6 million).

Expenses by Type (2008-09)



NRC incurred total expenses of $899 million in 2008-09, up from $853 million in 2007-08. NRC's major expense components – salaries and employee future benefits ($463 million) and grants and contributions ($133 million) are most important to NRC representing 66% of total expenses. NRC's most significant cost driver, salaries and employee future benefits, accounts for the majority of the $46 million increase in total expenses. Salaries and employee future benefits increased to $463 million, representing 51% of total expenses.

3.2 List of Supplementary Information Tables

The following tables are located on the Treasury Board Secretariat Web site:

- Sources of Respendable and Non-Respendable Revenue
- User Fees
- Details on Transfer Payment Programs (TPPs)
- Horizontal Initiatives
- Green Procurement
- Response to Parliamentary Committees and External Audits
- Internal Audits and Evaluations

3.3 Other Items of Interest

NRC Council Members

NRC's Council provides strategic direction and advice to the President and monitors progress against strategic plans. The Minister of Industry can also consult the NRC Council for advice on matters affecting NRC and of importance to science and technology in Canada. It usually meets three times a year and has four standing committees: the Executive Committee, the Human Resources Committee and the Audit, Evaluation and Risk Assessment Committee, and the Finance Committee. The Council is chaired by the President of NRC and the other members are appointed by the Government of Canada for three-year terms. Current members are:

- Pierre Coulombe, President (and Chair of Council), National Research Council, Ottawa, Ontario
- Dennis Anderson, Management Consultant, Libau, Manitoba
- Paul Clark, Former Vice-President, Research and Technology, NOVA Chemicals Corporation, Calgary, Alberta
- Peter Frise, Scientific Director and CEO, Auto 21, University of Windsor, Windsor, Ontario
- John Harker, President, Cape Breton University, Sydney, Nova Scotia
- Margaret Lefebvre, Executive Director, Canadian Association of Income Funds, Montréal, Québec
- Kellie Leitch, Assistant Dean (External), Chief/Chair of Paediatric Surgery and Assistant Professor, Paediatric Orthopaedics, University of Western Ontario, London, Ontario
- Douglas MacArthur, President, MacArthur Group, Inc., Charlottetown, Prince Edward Island
- Eva Mah Borsato, President, Intellectual Capital Corporation Inc., Edmonton, Alberta
- Howard Tennant, President Emeritus, University of Lethbridge, Lethbridge, Alberta
- Normand Tremblay, Strategic Management Consultant, Normand Tremblay and Associates, Montréal, Québec
- Allan Warrack, Professor of Business Emeritus, University of Alberta, Edmonton, Alberta
- David Wood, Head of Finance and Corporate Development, Secretary and Treasurer, Celator Pharmaceuticals Inc., Vancouver, British Columbia